

Analysis of Maritime Security Business Safety Construction Business With Analytical Network Process Model

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Abstract—The main problem in the shipping industry in Indonesia is the sluggishness of the shipping business due to under-considered risk management. In the period of 11 years from 2007 to 2018, the problem in this study was how to determine the priority of choices that could be taken into consideration in the shipping industry. The research objective is to get priority actions that can be taken in advancing the shipping industry business. The method used in this study is respondent data collection by data analysis using the Analytic Network Process (ANP). The results of research that discusses how to manage the risk that is at the highest priority with a weight of 0.39092. Next is the process of maintaining business with a priority weight of 0.27899, implementation with a priority weight of 0.18325 and also a low priority management oversight with a priority weight of 0.14684. Future opportunities are to consider and consider risk management arrangements.

Index Terms—Shipping industry, business continuity, analytical network process.

I. INTRODUCTION

IN 2018, obtained some data from the Indonesian National Shipowners Association (INSA) combined with data from the Ministry of Transportation that there are 3,918 sea transportation industries and 1,600 industries/companies that have become INSA members with a total number of vessels of 12,500. Whereas currently, the number of vessels registered at the Indonesian Ship Classification Agency (BKTI) is 10,580 ships, this means only 84.64% are registered. While INSA's vessels can be grouped into several types of ships, namely container ships, cargo ships, offshore vessels, passenger transport vessels, Roro ships, gas cargo ships, non-oil ships, bulk cargo ships, bulk carriers, tugboats, and barges and liquid cargo ships.

Based on the types of maritime insecurity, what needs to get more attention from shipping companies is a direct and indirect crime that threatens to harm the company, including piracy, and theft of facilities onboard and luggage. Attention is not limited to shipping companies that have gone public, but as a whole including up to traditional shipping companies. This attention needs to be done by the shipping company itself that prepares the mechanism up to the Standard Operation Procedure along with the equipment and training of crew members. Institutions related to efforts to safeguard the security and safety of shipping, namely the Navy, which in this case is

TABLE I: Crime Data in the Indonesian Ocean Territory 2014 2018

No	Types of Violations	2014	2015	2016	2017	2018
1	Breach of territory	20	6	20	24	11
2	Illegal Fishing	32	31	44	43	153
3	Illegal Logging	0	1	2	0	4
4	Mining, fuel oil, drugs	3	7	29	14	78
Amounts		55	45	95	81	316

tasked with enforcing the law and maintaining security in the sea territory of national jurisdiction following the provisions of national law and international law which has been ratified (Law no 34 of 2004). Furthermore, the Maritime Security Agency is tasked with conducting security and safety patrols in Indonesian territorial waters and Indonesian jurisdictions. (Presidential Decree No. 178 of 2014). The Directorate of Sea Transportation at the Ministry of Transportation is tasked with formulating and implementing policies and technical standardization in the field of sea transportation (Presidential Decree No. 40 of 2015). Based on data from the Naval Operations Staff, a recapitulation of violations at sea for violations of territorial boundaries, illegal fishing, illegal timber transportation, and other crimes such as mining goods, fuel, and drugs, are presented in Table I.

Based on the data in Table I, it is necessary to have maximum effort in ensuring the continuity of the shipping industry's business. Some order of priority decisions in ensuring the sustainability of the shipping industry's business is largely determined by the risk management function. Research on risk management has been carried out by Filipović, Krišto, and Podrug in 2018 which explains the influence of different crises on the development of business continuity management [1]. Some correlations between the crisis and the development of business continuity management have shown that the high risk in a crisis will also increase the degree of business continuity management development. Besides, strategic and operational risks have more influence on developing business continuity management from natural disasters. Also, unwanted risks affect the development of business continuity management more than intentional risks. The main contribution of this paper lies in modeling the development of business continuity management related to different crises and the likelihood of a crisis recurrence. This concerns the business risk management function. The important thing is the need to arrange business

continuity management in the face of uncertainty due to the disruption of the security and safety of business processes.

Besides that, based on research from Arief and Yuliani (2014) shows that the implementation of Law Number 17 Year 2008 regarding shipping is still not optimal to be implemented. Factors that need to be considered in implementing the policy on shipping safety are equipment and safety equipment that must be provided, seaworthiness, good navigation, every ship sailing is under the supervision of the port administration. As an illustration, the implementation of ship safety is not yet optimal with the number of ship crashes either sinking, burning, collision or aground. As an illustration of the magnitude of the challenge of shipping is the number of ship accidents that occur. The following are vessel accident data based on investigative data from the National Transportation Safety Committee (NTSC) until March 2018, as in Table II.

Maritime security governance which, due to the complexity of the problem and its relationship with the many institutions, has urgently needed to be improved so that it can provide security guarantees for maritime economic activity. With guaranteed maritime security, it is expected to be able to increase economic activities in the maritime sector, which consists of various shipping industries engaged in this sector, as well as other communities traditionally involved in economic activities in the marine sector. The unavailability of one or several of these key elements could potentially cause the entire shipping industry to be in trouble.

Developing, implementing and embedding business continuity into the company's management system will help reduce the impact of disruptions on work practices and service delivery. The Business Continuity Management System will help companies to minimize their risks and their likelihood of experiencing disruption. However, if the worst happens, a good business continuity management system will help an effective and quick recovery after helping protect the company's operations. Furthermore, with the increasing effectiveness of maritime security management in the shipping industry, it is expected to further enhance the business continuity of the shipping industry. Following research from [2], [3], [4], [5], [6], [7] that business continuity is a priority of management oversight, risk management functions and documentation of the plan and documentation of the business maintenance process. The continuity of the shipping industry's business is very much needed in the development of a maritime country like Indonesia so that it certainly can also contribute to the continuity of national development.

From the various explanations above, the identification of maritime security management and risk management in the effective shipping industry is a major challenge in the hope of improving the business continuity of the shipping industry. Then the problem formulation of this paper is how the priority of management actions, risk management functions, documentation of plans and processes to maintain business on the continuity of the shipping industry business.

This paper is organized as follows. The first part is the introduction. The second part discusses the research method. The third part contains results and grading. Finally, the fourth part describes the conclusions.

II. MATERIAL AND METHODS

A. Business Continuity of the Shipping Industry

Hecht [2] defines business continuity as "about ensuring that critical business functions can continue" or about ensuring that important business functions can continue. Bajgoric [3, p. 450] further explained that "The term 'Business Continuity' has been introduced to emphasize the ability of a business to continue with its operations even if some sort of disaster occurs." or the business's ability to continue operations even if certain types of disasters occur. Based on Hecht's theory, a company that has business continuity is a company with a high ability to handle accidents and disasters that allow large losses to the company, but the company can rise and survive.

Another definition by Bajgoric and Moon [3, p. 74] is "The term, 'business continuity' (business continuity, business resilience) refers to the ability of a business to continue with its operations even if some sort of failure or disaster occurs.", or the ability of a business to continue operations even if some failure or disaster occurs. Bajgoric and Moon's definitions explain that although there are many events.

B. Maritime Safety Regulations

Maritime security requirements for shipping companies can be referenced from various sources. In some literature, these sources are divided into three groups. The first group includes regulations proposed by different international organizations. An applicable legal document governing maritime security is the International Ship and Port Facility Security Code (ISPS Code) (International Maritime Organization, 2002). This entered into force on 1 July 2004, together with other amendments from the Safety of Life at Sea (SOLAS) Convention, and imposed a list of mandatory requirements on shipping companies and vessels involved in international shipping.

Both maritime security initiatives were introduced at the national and regional levels. This includes national state regulations, as well as programs, rules or agreements developed by various countries. This section contains a mixture of mandatory regulations and voluntary programs, each of which complies with international law.

Various existing regulations, both international, regional, national, and industry will be very helpful in improving the safety and security of shipping if carried out professionally. Furthermore, these regulations to be effective nationally need to be disseminated and implemented by the shipping industry in Indonesia. Referring to the number of existing sea transportation companies, it becomes important to conduct maritime security management at these companies. Maritime security management covers the issue of how the state manages maritime security effectively. According to the Big Indonesian Dictionary, effective words have meanings of effects, influences, effects or can bring results. So, effectiveness is the activeness, usability, the suitability in an activity of people who carry out the task with the intended target. Effectiveness shows the level of achievement, often or always associated with an understanding of efficiency, even though there are differences between the two. Effectiveness emphasizes the results achieved, while efficiency looks more

TABLE II: Ship Accident Data Based on KNKT Investigation Data

No	Year	Accidents	Drowning	Firing	Collision	Foundered	Others	Deaths	Injury
1	2012	4	0	2	2	0	0	13	10
2	2013	6	2	2	2	0	0	65	9
3	2014	7	2	3	2	0	0	22	4
4	2015	11	3	4	3	1	0	85	2
5	2016	18	6	4	3	3	2	46	18
6	2017	34	6	14	6	6	2	42	2
7	2018	9	5	2	0	0	2	33	-

at how to achieve the results achieved by comparing the inputs and outputs. Based on the description above it can be concluded that effectiveness is a condition that shows the extent to which plans can be achieved. The more plans that can be achieved, the more effective these activities are so that the word effectiveness can also be interpreted as the level of success that can be achieved from a particular way or effort following the objectives to be achieved. So the effectiveness of maritime security management can be interpreted as the level of success achieved by maritime security management in managing maritime security.

C. Analytical Network Process (ANP) Method

Data collection is done by filling out prepared questionnaires. Each selected expert respondent gets an application letter to fill out the questionnaire. After collecting the data, the next step is to analyze the data using ANP. Troubleshooting steps with ANP, compiled with calculation algorithms. The stages of analysis of the Analytical Network Process (ANP) method include:

- 1) Define the problem and determine the criteria that influence and the desired solution,
- 2) Make a pairwise comparison matrix that illustrates the contribution or influence of each element on each criterion. After gathering all the pairwise comparison data and entering the inverse value and the value of one along the main diagonal, the priority of each criterion is sought,
- 3) Determine the eigenvector from the matrix created in steps 2,
- 4) Repeating steps 2, 3, and 4 for each of the dependencies that exist,
- 5) Unweighted supermatrix by inserting all of the eigenvectors calculated in step 4 into the supermatrix,
- 6) Creating a clustered matrix by making a pairwise comparison for each dependency that exists between clusters.
- 7) Making weighted supermatrix by multiplying each content of unweighted supermatrix to the matrix comparison criteria (cluster matrix),
- 8) Looking for supermatrix limits by raising the weighted supermatrix continuously until the numbers in each column in a row are relatively equal, then normalize the supermatrix limits.
- 9) Take the value contained in the row that belongs to the alternative cluster from supermatrix and normalized as the final value.

TABLE III: Priority criteria for business continuity in the full model

1	Risk management Function	0.4951
2	The process of maintaining business	0.2309
3	Documentation planning	0.1643
4	Management Monitoring	0.1097

III. RESULTS AND DISCUSSIONS

A. The Effectiveness Model of Maritime Security Management (EMKM) on Business Continuity

Modeling is done based on a hypothetical model which is then compiled in the Analytical Network Process (ANP). In this model with ANP, priority criteria and relationships between criteria are considered, alternative priorities for each criterion and relationships between alternatives. Overall the model is arranged in Fig. 2.

B. Priority for Business Continuity

Furthermore, the priority of business continuity criteria in the complete model based on the synthesis of the weighted supermatrix calculation results are shown in Table III.

Thus, in business continuity, the Risk Management Function (FMR) with a priority of 0.4951 is the criterion with the highest priority. Then in a row the process of maintaining a business (PMB) with a priority of 0.2309, Documentation of the Plan (DR) of 0.1643 and Management Oversight (PM) with a priority of 0.1097. Based on the order of priorities, business continuity is largely determined by the risk management function. This is consistent with the research of Filipović, Krišto, and Podrug [1] which explains the effect of different crises on developing business continuity management. The correlation between a crisis and the development of business continuity management shows that increasing the risk of a crisis will increase the degree of business continuity management development. Also, strategic and operational risks have more influence on developing business continuity management from natural disasters. Also, unwanted risks affect the development of business continuity management more than intentional risks. The main contribution of this paper lies in modeling the development of business continuity management related to different crises and the likelihood of a crisis recurrence. This concerns the business risk management function. The important thing is the need to arrange business continuity management in the face of uncertainty due to the disruption of the security and safety of business processes.

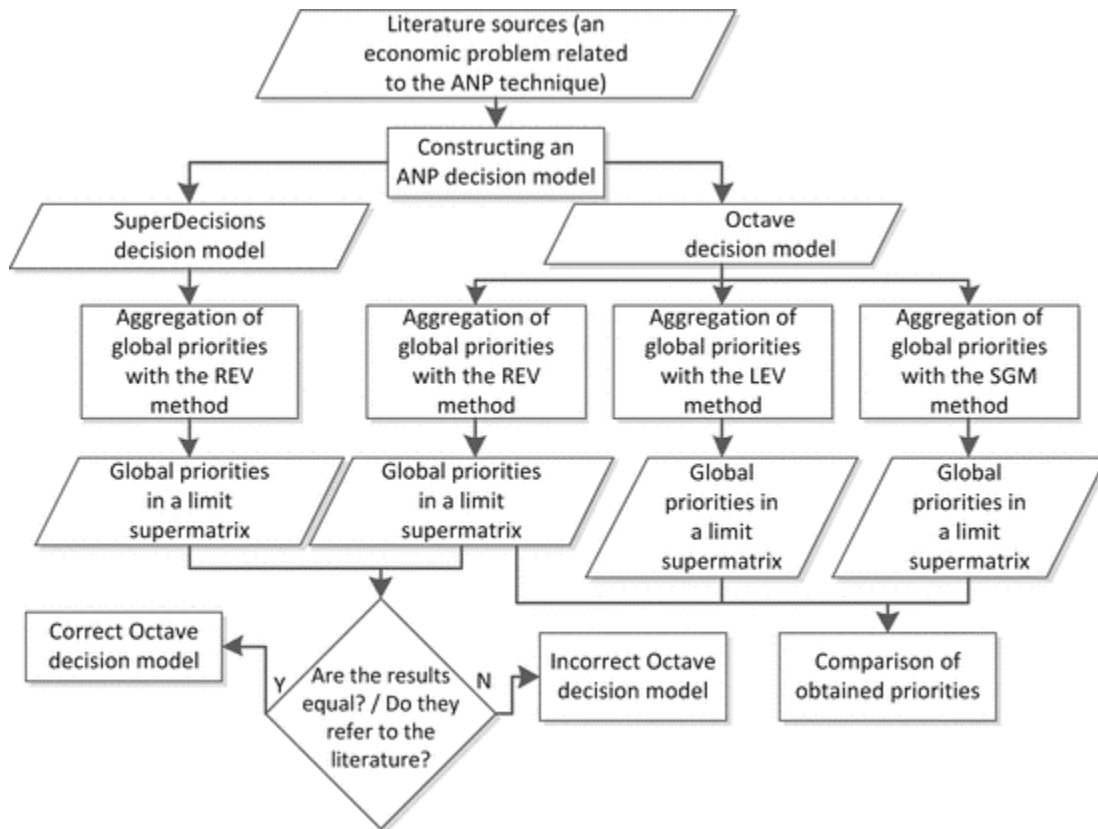


Fig. 1: Analysis Algorithm with ANP Method.

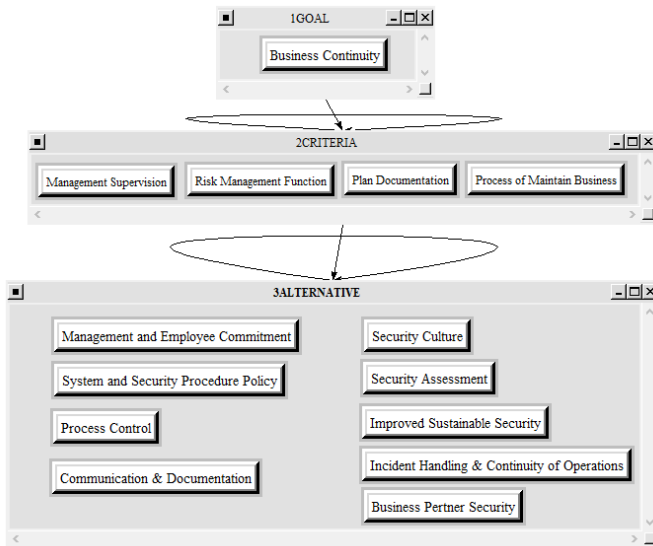


Fig. 2: EMPM ANP Model for Shipping Business Business Continuity.

These results also indicate that the risk management function is a very important criterion as the ability to maintain business continuity. As stated by [4] that business continuity is “the ability of a business to continue with its operations even if some sort of disaster occurs”. So the company’s ability to manage the risks faced in its business processes is very

important. On the voyage, the possibility of accidents and insecurity of the voyage from interference is very high. Of course, this requires the preparedness of crew along with all equipment and ships to anticipate and cope to minimize business disruption as stated by [8]. This is an important part of the risk management function.

The next research result which is quite important as priority is the process of maintaining business. This is in line with the opinion of Castillo [5] that business continuity as “the ability to retain a revenue stream through a crisis” or the ability to maintain revenue flows through a crisis. So the way is by the process of maintaining the business. To get the ability to maintain business continuity requires careful planning support as a general management function that planning is one of the main keys to management’s success. Furthermore, good planning is not optimal when it is not well written and documented, because the shipping business is a business with a lot of resources and is expensive and requires a long time in business processes.

Furthermore, to ensure that all plans are implemented properly requires management supervision. So that the entire business process goes well. Especially when faced with a threat or security and safety disturbance, it can still be overcome by a mature plan that has been prepared and well documented to maintain business and control existing business risks and in turn, the company can maintain business continuity.

TABLE IV: Priority Alternatives for the Risk Management Function Cluster Criteria

Alternatives	Normality priority
Business Agreement Analysis	0.16541
Asset Identification & Documentation	0.14538
Identification of Assets & Business Disturbances	0.20269
Recovery Procedure Priority	0.2292
Terms & Purpose of Business Selection	0.13989
Important Recovery & Processing Time	0.11744

TABLE V: Priority EMKM on Business Continuity

1	Business Partner Security	0.2212
2	Security Culture	0.1926
3	Handling of Incidents and Continuity of Operation	0.1461
4	Management and Employee Commitments	0.1121
5	Communication and Documentation	0.0794
6	System Policies and Security Procedures	0.0765
7	Process Control	0.0710
8	Safety Assessment	0.0724
9	Enhanced Sustainable Security	0.0285

C. Mathematical Model of Business Continuity

Furthermore, based on the results of the calculation of the priority weights of the four business continuity criteria above, a linear model can be drawn up to accommodate the weights of each criterion. The business continuity model can be arranged as follows:

$$\text{BusinessContinuity} = 0.4951FMR + 0.2309PMB \\ + 0.1643DR + 0.1097PM,$$

where *FMR* denotes risk management function, *PMB* denotes the process of maintaining business, *DR* denotes plan documentation, and *PM* denotes management supervision.

Based on the model, the shipping industry can pay attention to the four criteria according to the priority weights set in the model. So the shipping industry can get guidance on how efforts and resources are oriented to get increased business continuity, both human resources, equipment, facilities, and funding. Optimizing the improvement of the company's business continuity is done through priority orientation of the use of resources following weighting.

D. Effectiveness of Maritime Security Management (EMKM) on Business Continuity

Furthermore, based on the results of calculating EMKM priorities on business continuity, it can be arranged by the following Table VI.

Referring to Table VI, the highest priority on the effectiveness of maritime security management (EMKM) is the security of business partners with a weight of 0.2212. Next in a row on security culture with a weight of 0.1926; incident handling and continuity of operations with a weight of 0.1461; commitment of management and employees with a weight of 0.1121; communication and documentation with a weight of 0.0794; system policies and security procedures with a weight

of 0.0765; safety assessment with a weight of 0.0724; process control with a weight of 0.0710; and the last is continuous security improvement with a weight of 0.0285.

Based on the understanding of the effectiveness of maritime security management namely the effectiveness of maritime security management can be interpreted as the level of success achieved by maritime security management in managing maritime security, the results of this study indicate that the security of business partners is the highest priority. Because the shipping business is a service business. Business cannot go on or die if there are no business partners as customers. Therefore, the security of business partners is the highest priority in shipping. When shipping companies can maintain the security of business partners both human and cargo and goods delivered, the security of business partners is maintained and increases the confidence and confidence of business partners in the credibility of the shipping company and remains a customer.

The security of the business partners and the shipping company business processes is maintained if there is a security culture in the company which means the way of life carried out by the crew and the ship management as well as the shipping industry is a way of life that prioritizes security aspects. This is important because the sea has the uniqueness of high terrain uncertainty, in addition to the possibility of high security and safety disturbances as well, as data from the NTSC (2018) that accidents per year averaged 13 ships per year and Regional Cooperation Agreement on Combating Piracy data and Armed Robbery against Ships in Asia (ReCAAP) in the 2018 Annual Report Piracy and Arm Robbery Against Ship Asia which shows experimental data, actual and total piracy, and armed piracy carried out on ships in Indonesian waters from 2007 to 2018 on average total reached 42 events.

Based on this, then the handling of incidents that occur, whether an accident or piracy and piracy becomes the next priority. This, especially concerning human safety issues, which on average killed 44 people and lost 9 people (NTSC, 2018). Furthermore, the handling of ships, property, and ship engine spare parts.

Specifically for cargo and cargo security, it is also important to consider the relationship with the security of business partners to avoid losses that can affect business confidence and business continuity. As an illustration, 2007 - 2018 based on data from the Regional Cooperation Agreement on Combating Piracy and Armed Robbery against Ships in Asia (ReCAAP) in the 2018 Annual Report Piracy and Arm Robbery Against Ship Asia shows a fairly large loss that is the average cargo runs out every year occur and loss of cargo of 14 events, so it is important to anticipate.

E. EMKM Mathematical Model of Business Continuity

To provide guidance and make it easier for shipping companies to implement maritime security management to maintain business continuity, it is necessary to develop a mathematical model that is simple but has a large impact when implemented. Furthermore, a linear model can be arranged on the Effective-

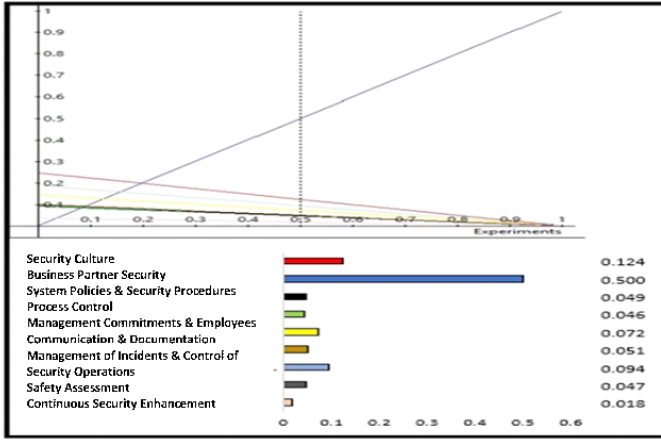


Fig. 3: Analysis diagram of Maritime Security Management Sensitivity (MKM) on Business Continuity.

ness of Maritime Security Management (EMKM) on business continuity according to the weight of each criterion, as follows:

$$\begin{aligned} BusinessContinuity = & 0.221KMB + 0.193BK + 0.146PIKO \\ & + 0.112KMK + 0.079KD + 0.077KSPK \\ & + 0.072PK + 0.071KP + 0.029PKB, \end{aligned}$$

where *KMB* denotes business partner security, *BK* denotes security culture, *PIKO* denotes handling of incidents and continuity of operations, *KMK* denotes management commitment and employees, *KD* denotes communication and documentation, *KSPK* denotes system policy and security procedure, *PKB* denotes continuous security enhancement, *KP* denotes process control, and *PK* denotes security assessment.

Based on the above model, to improve business continuity, maritime security management needs to be prioritized by shipping companies with weights according to the model. To obtain optimal business continuity results, efforts are made to improve each criterion in maritime security management according to priority weights. Shipping companies can use this model through the use of resources owned by shipping companies oriented to each criterion according to the weight of each criterion.

F. Sensitivity Analysis

Furthermore, from the EMKM model, sensitivity analysis is performed. Sensitivity analysis is used to analyze how the priorities of alternative solutions change when variations in the priority of one or more decision-making factors (criteria) are made. This analysis is used to ensure that the results of calculations performed with ANP provide good sensitivity. From the calculation results above, the sensitivity analysis results obtained with various experiments to determine the level of sensitivity of the MKM calculation results on business continuity. The analysis results are presented in Fig. 3.

Based on the experimental results of the sensitivity of the maritime security management model to business continuity, it can be explained that changes in the form of a 50% and 75% increase in the security priorities of business partners

result in changes that are appropriate to other alternatives without changing the order of weights. Whereas the reduction in the weighting of business partner security priorities must be balanced with an increase in security culture so that maritime security management in business continuity is maintained.

G. Managerial Implications of the Shipping Industry

The results showed the relationship between maritime security management and the continuity of the shipping industry's business. This is consistent with the Governance Risk Management Compliance (GRC). Simply put, the relationship between these three concepts begins with the determination of compliance requirements through applicable regulations (compliance, C) in this case managed by the Directorate General of Sea Transport and in operational activities conducted by the Navy and Bakamla. Furthermore, the risk of non-compliance arising from this requirement is managed by risk management (in this case the shipping company conducts management so that the business process can continue and be successful. Finally, the risk management plan is implemented through control by the governance of the shipping company (Governance). The process returns to the first part by evaluating the results of the handling of the achievement of compliance requirements. GRC can be used methodologically to improve company decisions, both tactical and strategic.

Based on the results of the study, it appears that the main priority of business continuity is on the criteria for the Risk Management Function and the Business Sustainability Process while the other two criteria, namely planning documentation and management oversight, are used to improve risk management governance so that higher results are achieved. Furthermore, alternatives to the risk management function, which are priority recovery procedures and identification of assets and business interruptions, and the process of maintaining business, namely the ability to solve problems and trust to get credit are the main priorities in maintaining business continuity. Thus, the management of the shipping industry needs to pay attention to the four main things in maintaining business continuity, namely business recovery procedures, identification of assets and business disruptions, ability to resolve problems and trust to get credit. When business continuity disruptions occur due to security disturbances, what needs to be prepared, maintained and trained for ship managers and companies is (1) procedures for business recovery so that they can be maintained and improved, (2) identify assets owned by the company and vessels and assets business partners, (3) resolving the problem of security disturbances, and (4) very important is the ability of business communication and interaction to continue to gain the trust of the banking world as proof of the company's credibility so that it can still gain the trust to obtain credit to continue to maintain the continuity of the company's business.

The management of the shipping industry must strive to improve quality through business partner security priorities, security culture and incident handling and continuity of operations. Efforts that can be made by industry management, especially in education and training in handling incidents and

TABLE VI: Priority EMKM on Business Continuity

No	Sensitivity Analysis	-75%	-50%	+50%	+75%
1	Security Culture	0.234	0.22	0.165	0.152
2	Business Partner Security	0.055	0.111	0.332	0.387
3	System Policies & Security Procedures	0.093	0.087	0.066	0.06
4	Process Control	0.086	0.081	0.061	0.056
5	Management Commitments & Employees	0.136	0.128	0.096	0.088
6	Communication & Documentation	0.096	0.091	0.068	0.063
7	Management of Incidents & Control of Security Operations	0.177	0.167	0.125	0.115
8	Safety Assessment	0.088	0.083	0.062	0.057
9	Continuous Security Enhancement	0.035	0.033	0.024	0.022

shipping security disturbances as well as completing the equipment needed to handle incidents that can occur. Continuous education and training before and during the voyage are conducted to cultivate security for the crew, with priority training on business partner security ranging from human/passenger security, cargo/freight transportation, and document security.

IV. CONCLUSIONS

From the explanation above, the conclusion of the research is for business continuity in selected business continuity, namely the priority of the Risk Management Function with a priority of 0.39092 as the criterion with the highest priority. Next is maintaining business processes with a priority of 0.27899, then Documentation Package 0.18325 and Management Oversight with a priority of 0.14684 so that the highest priority for the business continuity of the shipping industry is the risk management function. The priority priorities in the highest risk management function criteria are as follows: Priority for Recovery Procedures, Identification of Business Assets & Disruptions, Analysis of Business Agreements, Identification & Documentation of Assets, Requirements & Objectives of Business Selection, and Important Recovery & Processing Time.

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